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# MEMORANDUM

DEPARTMENT OF HEALTH, EDUCATION AND WELFARE  
PUBLIC HEALTH SERVICE  
CENTER FOR DISEASE CONTROL  
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

TO : Acting Director, DSNEFS

DATE: January 26, 1976

THRU : Branch Chief, EIB PSD

FROM : Industrial Hygienist, EIB

SUBJECT: Benzene Exposure in Gas Stations

FILE COPY

① Copy Ken Bridgman  
have him talk to  
John Moran of EPA  
re benzene content  
of gasoline as a  
standard

## Literature Review

The presence of benzene in practically all crude oils has been recognized from almost the beginning of the petroleum industry.<sup>1</sup> Thus, it is no surprise that small amounts of benzene are found in all gasolines.

Runion has recently addressed this problem.<sup>2</sup> Key points from this paper are as follows:

- 1) Most gasoline produced in the U.S. today contains less than 1 liquid volume per cent benzene.
- 2) Volume per cent benzene in the vapor phase is less than half the value of the volume percent in the liquid phase.
- 3) Limited environmental monitoring indicates service station attendants exposures to be less than 10 ppm total gasoline vapor.

? total benzene content of gasoline  
maybe low about  
OK range 15-60  
only 2-5%  
maybe 10  
15-60

If this data is correct, then worker exposure to benzene is extremely low.

(10 ppm total gasoline vapor) (.5% benzene in vapor) = .05 ppm or 50 ppb benzene

Parkinson<sup>3</sup> conducted field investigations of benzene concentrations at nine gas stations in England. Three types of stations were included in the survey. His results are shown in Table I.

These benzene determinations are considerably higher than would be expected based on Runion's data. Indeed using Runion's data, total gasoline vapor

concentrations would have to exceed 100 ppm to reach the benzene concentrations found by Parkinson.

Sherwood<sup>4</sup> has evaluated benzene exposures during bulk loading operations. Mean benzene concentrations were reported as follows:

Loader 1	1.6 ppm
Loader 2	2.5 ppm
Weigher	20.0 ppm

#### CURRENT PROJECT PLANS

DSHEFS's Environmental Investigations Branch currently has a project entitled "Occupational Benzene Exposure - Env. Aspects". This project includes a \$46.5 K contract for determination of benzene contamination in industrial solvents. The following tasks would be performed:

- 1) Conduct a literature search to identify those solvents presently being used which have potential for benzene contamination.
- 2) Through the literature or contacts with producing companies, acquire all available data as to present and past benzene levels in industrial solvents.
- 3) Acquire, from the open market, samples of industrial solvents and perform qualitative and quantitative analyses for benzene using gas chromatography or other appropriate methods.
- 4) Prepare a final report summarizing the results of the literature searches and laboratory evaluations.

#### ALTERNATIVES

The determination of benzene in bulk gasoline samples could logically be performed under contract. The original scope of work could be expanded to include personal monitoring at service stations. This work could be conducted within six months after contract award. Alternatively, a pro-

gram to determine benzene exposure to gas station personnel could be conducted in-house.

If done in-house, the following is proposed:

Preliminary Study

time frame: 2 months

Preliminary sampling would be conducted at approximately six gas stations in the Cincinnati area.

The following parameters should be documented:

- 1) volume % benzene in gasoline
- 2) amount of gasoline pumped during sample period
- 3) number of gas pumps
- 4) meteorological conditions
  - a) temperature
  - b) humidity
  - c) wind speed and direction

Sampling would include:

bulk samples

personal samples

area samples

Analysis should be performed not only for benzene but other hydrocarbons present in appreciable quantities. Complete analysis of typical premium and regular-grade gasolines has been published.<sup>5</sup>

Acting Director, DSHEFS

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**Results:**

1. Validate sampling and analytical techniques
2. Collect preliminary data
3. Verify protocol for in-depth study

**In-depth Study**

time frame: 6 months

Conduct in-depth study using techniques developed in initial survey over a wide geographical region.

**Results:**

1. Document benzene exposure to gas station attendants over a wide range of meteorological conditions and geographical areas.

**PROBLEM AREAS**

Current sampling techniques may not be applicable for this study. To increase sensitivity, sampling could be conducted at higher flow rates for extended time periods. Another alternative would be larger charcoal tubes.

We currently do not have the proper equipment to monitor wind speed and direction. Supplier estimates 3-4 weeks delivery date upon receipt of purchase order.

Delays in existing projects would be encountered.

*Ronald J. Young*  
Ronald J. Young

TABLE 1. NORMAL OPERATIONS AT TYPICAL RETAIL FILLING STATIONS

Site type*	Weather		Gasoline			Benzene in air concentration			Total phenol in urine		
	General	Temp. (°C)	Wind (miles/hr)	Maximum benzene content (% v/v)	Throughput during test gallons	Duration of test (hr)	No. of tests	Mean (ppm)	Range (ppm)	Before work (mg/l.)	After work (mg/l.)
A	Changeable	15-17	8-12	3.7	850	1.4	28	2.3	1.3-2.9	—	—
A	Changeable	14-22	4-24	3.7	730	1.2	27	2.1	1.5-3.2	—	—
A	Sunny	15	1-16	2.8	360	5	16	0.3	0.3-0.4	1	5
A	Sunny	8	1	5.8	600	6	10	0.7	0.2-1.2	3	18
B	Changeable	18-20	19-24	3.7	28	4	4	2.4	2.0-2.8	—	—
B	Changeable	21	4-12	3.7	140	4	6	1.6	0.8-2.4	—	—
B	Sunny	16	1	3.1	155	3.5	8	0.5	0.3-0.9	5	9
B	—	—	—	5.5	150	6	12	0.3	—	1	5
C	Bright	16	1	3.4	500	6	10	0.8	0.4-1.1	4	12

## Type A

large and open  
built in accordance with oil company  
recommendations  
large annual throughput

## Type B

"typical filling station"  
medium sized  
somewhat enclosed  
average annual throughput

## Type C

dense urban areas  
very enclosed  
relatively high annual throughput

## References

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4. Sherwood, R.J.: Evaluation of exposure to benzene vapour during the loading of petrol. Br. J. Ind. Med. 29: 65-9, 1972.
5. Sanders, W.N. and Maynard, J.B.: Capillary gas chromatographic method for determining the C<sub>3</sub>-C<sub>12</sub> hydrocarbons in full-range motor gasolines. Anal. Chem., 40: 527-35, 1968.

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pcept?